

**NSF I/UCRC TECHNOLOGIES  
AND  
NATIONAL RESEARCH FACILITIES  
FOR  
HIGHWAY SAFETY RESEARCH AND  
VEHICLE DESIGN**

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**NATIONAL ADVANCED DRIVING SIMULATOR**



Panasonic MPEG1 Encoder



## APPLICATIONS AND IMPACT

- US Highway Safety Research Requires Fundamentally New Simulator Tool
  - Over 90% of crashes involve human error, so driver must be immersed in experiments
  - US Highway crashes kill over 41,000 persons per year, at a cost to society of \$230 billion
- Reduction in Time-to-Market of High-Quality Vehicle Products Requires Engineering Fidelity Virtual Proving Grounds



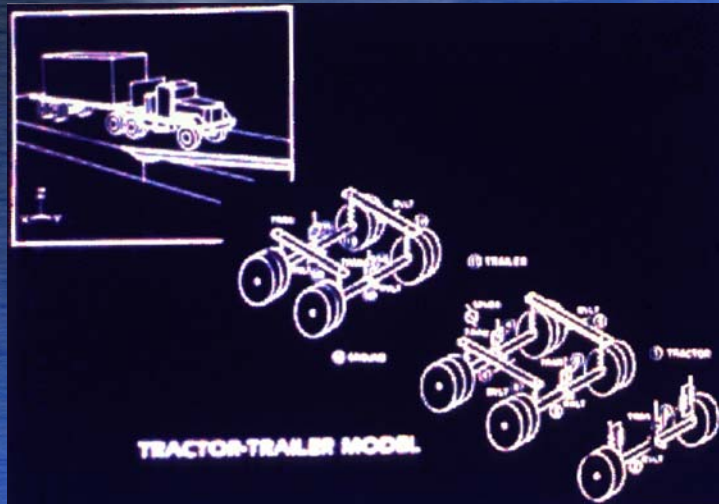




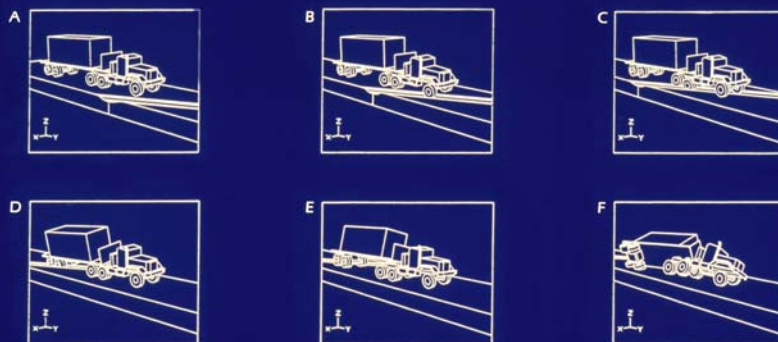
## ENABLING TECHNOLOGIES

- High-Fidelity Vehicle Dynamic Simulation
- Real-Time Vehicle Dynamic Simulation
- Precision, Large Excursion Motion Control
- Computer Graphics
- Virtual Environment Modeling

# HIGH FIDELITY TRUCK MODEL



# ANIMATION OF SIMULATION



## **1985 CPU TIMES FOR HIGH FIDELITY TRUCK ROLLOVER SIMULATION**

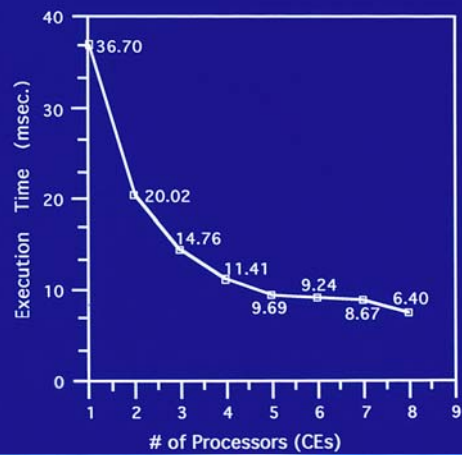
- Thirty Seconds of Actual Time Simulated
- Seven CPU Hours Required for Simulation on Then Mini-Supercomputer
- Seven CPU Hours Required for Graphics Rendering on Same Computer
- Factor of 2000 Slower Than Real-Time

## **1986 I/UCRC RESEARCH PROJECT**

- Cannot Solve High Fidelity Equations of Motion in Real-Time Using Serial Computers
- Researchers Have Derived New Formulation Using Variational and Vector Calculus
- Feasibility of Parallelism for Real-Time With This Class of Algorithms Will Be Explored
- If Achieved, Real-Time Dynamic Simulation Will Enable the Human to Function in an Interactive Design/Safety Research Environment



## 1987 PARALLEL DYNAMICS ON 8 PROCESSOR COMPUTER





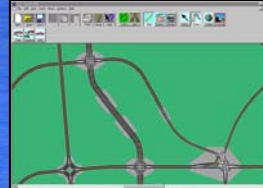




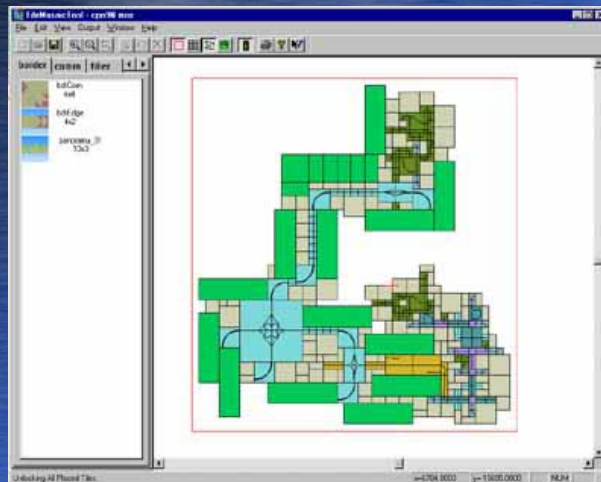


## **DATABASE AUTHORIZING TOOLS**

- Highway Traffic Control: Multiple-lane, High Density Traffic and Roadway Weather Environment
- Commercial, Industrial, Rural, and Residential
- Three-Dimensional Objects
- User-Friendly Scenario Definition and Control Tools



# TILE-BASED DATABASES



# TILE MODULES



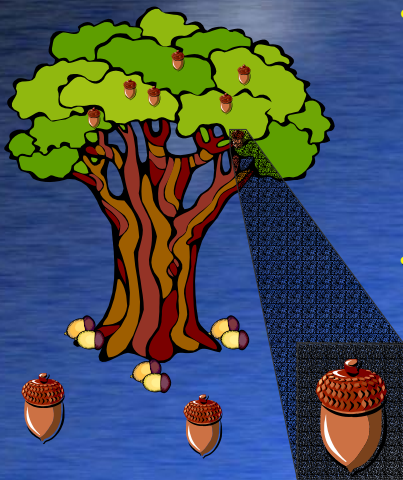
660 feet



## HIGHWAY SAFETY AND AUTOMATED HIGHWAYS APPLICATIONS



## “FROM A TINY ACORN, A MIGHTY OAK DOTH GROW”



- **Acorns: Enabling Technologies**

- NSF I/UCRC Developed
  - High fidelity dynamics
  - Real-time simulation
  - Virtual environment modeling
- Industry Developed
  - Computer graphics
  - Precision motion systems

- **Mighty Oak: New Capabilities**

- National Advanced Driving Simulator
  - \$80 million world class facility with I/UCRC
- US Highway Safety Virtual Environment
- Off-Road Vehicle Proving Ground